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Status of the Iceland Scallop Chlamys islandica on the Grand Banks of Newfoundland (NAFO Division 3LNO), 1994

by

K. S. Naidu, F. M. Cahill, P. J. Veitch, and D. E. Stansbury
Science Branch
Department of Fisheries and Oceans
P. O. Box 5667
St. John's NF A1C 5X1 Canada

[1]This series documents the scientific basis for the evaluation of fisheries resources in Atlantic Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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[1]La présente série documente les bases scientifiques des évaluations des ressources halieutiques sur la côte atlantique du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

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Abstract

Although attempts have been past made to commercialize deposits of the Iceland scallop, Chlamys islandica, over the Grand Bank of Newfoundland, fishing activity did not begin in earnest until 1993. Ten vessels harvested approximately 560 t round. Interest in 3LNO scallops mushroomed in 1994 with 57 vessels landing 4,500 t.

Two areas were surveyed in 1994, one each in NAFO Div. 3N (867 mi^2) and Div. 3L (348 mi^2). Minimum dredgeable biomass (MDB) in 3N was estimated at 4,600-10,500 t ($\bar{x}$ = 7,600 t) round; in 3L, the MDB was estimated at 1,500-6,700 t ($\bar{x}$ = 4,100 t) round.

The decline in overall CPUE's, the reduction in the proportion of large meats to small ones in the catch and the concomitant decline in research vessel abundance indices all point to stock depletion. A cautious experimental management strategy is proposed for both areas.

Résumé

Bien que l'on ait auparavant tenté de commercialiser les gisements de pétoncle d'Islande *Chlamys islandica* des Grands Bancs de Terre-Neuve, l'activité de pêche n'a pas commencé sérieusement avant 1993. Dix bateaux récoltaient alors environ 560 tonnes brutes du mollusque. L'intérêt pour les pétoncles de 3LNO s'est grandement accru en 1994, année où 57 bateaux ont débarqué 4 500 t de prises.

Deux secteurs ont fait l'objet d'un relevé en 1994, l'un situé dans la division 3N de l'OPANO (867 mi^2) et l'autre dans la division 3L (348 mi^2). La biomasse minimale dragable (BMD) dans 3 N a été estimée à 4 600-10 500 ($\bar{x}$ = 7 600) tonnes brutes; dans 3L, elle a été estimée à 1 500-6 700 ($\bar{x}$ = 4 100) tonnes brutes.

La baisse des PUE générales, la réduction de la proportion de grosses chairs par rapport aux petites dans les prises et le déclin concomitant des indices d'abondance des relevés de recherche dénotent tous un épuisement du stock. On propose une stratégie expérimentale de gestion0 prudente dans les deux secteurs.

Background

Numerous surveys both public and private have been conducted over the years in search of scallops on the Grand Banks of Newfoundland. Most of the earlier surveys were directed at sea scallops by larger Maritimes-based vessels (eg. Dickie and Chiasson 1955; Somerville and Dickie 1957; MacPhail and Muggah 1965; Rowell et al. 1966a, 1966b). Much of the earlier work simply gave us some idea of presence or absence of Iceland scallops.

A decade of declining catches of sea scallops from Georges Bank beginning in 1975 and the uncertainty then surrounding the Canada/U.S. jurisdictional dispute over Georges Bank rejuvenated interest eastwards including the Grand Banks of Newfoundland. There also was an interest in the Iceland scallop hitherto unutilized by the offshore fleet. This interest was in part facilitated by the availability of mechanical shucking devices for bulk extraction of meats.

The first formal directed survey for the Iceland scallop commenced in 1982. The survey was conducted through an unsolicited proposal (U.P.) from Commar Management Consultants Ltd. of Halifax. In preparation for this survey Naidu (cited by Mobil Oil Canada Ltd., 1985) made a retrospective search of its occurrence in the bycatch of Department of Fisheries and Oceans (DFO) research vessel surveys spanning some 40 years (Fig. 1). This information, together with other ancillary information from Canadian Hydrographic Field Sheets, was used to generate an exploratory survey design to investigate the overall distribution and abundance of Iceland scallops over the entire Grand Banks of Newfoundland (NAFO Div. 3LNO). Fisheries Development Branches (FDBs) from Nova Scotia and Newfoundland Regions supported the unsolicited proposal. Science Branch (Newfoundland Region) generated an acceptable survey design, familiarized sea-going personnel with sampling protocols, etc. Two commercial scallop draggers were chartered for the survey (M.V. CHARLOTTE LOUISE and M.V. CHARLOTTE & RICKEY) (Rodger and Davis 1982).

Approximately 47,000 mi^2 of 59,070 mi^2 in 3LNO was surveyed during the 58 charter days (Fig. 2). Areal distribution of fishing sets was such that the Grand Bank was somewhat thoroughly surveyed. However, navigational constraints beyond Decca's zone of reliability precluded adequate coverage of the shelf beyond about 150 mi from land, including the nose and tail of the Bank.

Overall, three separate areas were identified in 1982 as having some commercial potential. Only 17 out of 1091 one-mile tows produced catches equal to or greater than 2000 scallops/tow. The sporadicity of good catches suggested that the occurrence of massive beds to be highly unlikely. In spite of this uncertainty the media was abuzz with premature reports of a major scallop discovery. The press heralded the find with headlines such as "Grand Bank Scallops Discovered" and "Rare Scallop Find on the Grand Banks". It was even reported that one of the beds near the Virgin Rocks covered some 1,100 mi^2!

Convinced of the commercial viability of this resource and the coming of age of mechanical shucking devices, some Canadian concerns quickly poised themselves to participate in the fishery. One of them brought in a 67 m factory trawler from Norway. The M.V. ATLANTIC ENTERPRISE commenced experimental fishing on the Grand Banks in January 1989. Although she completed 2084 x 5 m rake tows over a 20-day period, catches were reported to be dismal with only 2.7 t (6000 lb) of meats taken! The majority of catches came from an area east of the Virgin Rocks (Eastern Shoals) and from the Lilly Canyon (Naidu and Cahill 1989, 1990). Understandably industry was stymied.

DFO (Newfoundland Region) commenced its own scientific survey in 1989. Because of the very large area involved and limited shiptime, we decided to undertake this task in instalments. NAFO Div. 3N was selected for the first phase. A stratified random survey using the groundfish depth-based stratification scheme was employed. A total of 152 pre-assigned sets distributed over 11 strata covering some 15,750 mi^2 was completed (Naidu and Cahill 1990, Fig. 3). Additional sets (N = 44) were run in and around areas where moderate to good catches were encountered.

Of the 152 pre-assigned stations, only 66 (43%) produced scallops. Most of the catches came from north of 44°30'. Catches were highly variable, again pointing to the very patchy distribution characteristic of this species (Gilkinson and Gagnon 1991). Overall, better catches ($\geq$ 500 scallops/tow) came from two areas, one just southwest of Carson Canyon in a 75 mi^2 area between 31-50 fm and the other (approximately 15 mi^2) in the slope area straddling the 31-50 and 51-100 fm isobaths off the Lilly Canyon (Fig. 4). As expected, the multiplicative effect of the areal expansion technique gave spuriously high and unrealistic estimate of biomass. Consequently, separate patch estimates for the two aggregations were also developed (Naidu and Cahill 1990).

1994 Research Survey

In our most recent (1994) survey we directed all fishing sets into these two areas taking into account the most recent fishery information. As well, we also surveyed an area in 3L which in 1993 accounted for the majority of removals (99%) (Fig. 5). Fishing and sampling methodology was the same as that used in previous Science Branch scallop surveys (eg. Naidu and Cahill 1990). We discuss these areas separately.

NAFO Div. 3L

Seventy-three (73) sets were run in an area covering 348 mi^2 equivalent to approximately one set/5 mi^2 (Table 1). Mean catch weight, numbers and depths fished are summarized in Table 2. Mean and modal shell heights were 73.6 mm and 76.0 mm respectively with a size range of 21-101 mm (Table 3). Average biological count/500 g was 63.3 with an overall meat yield of only 9.2% of shellstock (Table 4). Scallops from 3L carry an inordinate weight burden of barnacles contributing to as much as 26-47% of the total round weight (x = 34.0%).

Minimum dredgeable biomass (MDB) within the area surveyed was estimated at 1,500-6,700 t (x = 4,000) shellstock (Table 5). Defining commercial aggregations to be ≥ 20 kg/tow we determined that 70% of this biomass (2,800 t) to be confined to within one quarter (26%) of the area (89 of 348 n mi^2) surveyed (Table 6). Using a 20% gear efficiency and allowing for weight contributions from barnacles total biomass is estimated at 4,000-15,000 t (x = 9,500 t) round.

NAFO Div. 3N

One hundred and seventy-eight (178) sets were completed in the target area (867 mi^2), again equivalent to approximately one set/5 mi^2 (Table 1). Mean weights, numbers and depths fished are summarized (Table 2). Not only were scallops from 3N significantly larger than those from deeper water in 3L (Table 3), but average meat weight at a given shell size (SH) was also higher (Table 7). Overall yield was estimated at 14.5% (Table 4). The higher yields resulted not only from the larger meats at a given size but also because the shells were relatively clean of epibionts. Of 29 samples examined only three had any amount of barnacles with an overall average weight burden estimated at 6.5%.

MDB over the survey area in 1994 was estimated at 4,600-10,500 (x = 7,600) t round (Table 8). However, MDB within aggregations likely to attract commercial effort is estimated to be 3,900-7,600 t (x = 5,700 t) (Table 6). Again at 20% gear efficiency, biomass is estimated at 19,600-38,000 t (x = 28,800 t) round. Mean research vessel catch rates in this area had dropped by 50% in comparison with the 1989 survey (17.3 vs 35.2 kg/tow mile). Fishery-induced mortality as determined by the ratio of clucker numbers to live scallops had also increased (Table 9).

Fishery

The directed fishery for Iceland scallops on the Grand Banks by Newfoundland-based vessels is quite recent. After several years of exploratory fishing and commercial trials, fishing activity began in earnest in 1993 with a total of 10 vessels participating. A total of 459 t round was landed (Table 10). The majority of removals was from NAFO Div. 3L, the remainder was from 3N (one vessel only). Approximately 95% of the effort was directed into an area centred approximately at 47°15'N, 49°15'W, about 140 mi east of St. John's (Fig. 5). A variety of gear types was used in 1993 including the offshore New Bedford type rake, Digby buckets, and the Labrador rake. Catch rates were highly variable with meat counts in the 40-80/lb range.

Interest in 3LNO scallops continued to mushroom in 1994. A total of 57 vessels participated in the fishery, with total removals at 4500 t. Sixteen vessels in the 50-64 ft L.O.A. accounted for about 80% of overall landings from 3LNO. However, the majority (98%) of removals in 1994 came from the highly productive grounds near the Lilly Canyon/Carson Canyon areas in 3N where a total of 1451 vessel days had been expended. Scallop meats in this

area were large for a given shell size with the majority in the 30-40/lb range. A marked reduction in the percentage of larger meats was evident through the 1994 season (Table 11). Overall mean daily catch/tow decreased through the season (Fig. 6).

Resource Status and Perspectives

Preliminary assessments which began in 1990 for 3Ps Iceland scallops had suggested that interim removals of 20% of biomass would be consistent with an $F_{0.1}$ exploitation of that resource. We had cautioned that the TAC recommended was preliminary and was based on rather optimistic Y/R computations extrapolated from a faster growing population elsewhere on the bank. Experience in other countries suggest that an exploitation rate of 20% is too high for this species. In Norway, exploitation rates of 3-5% have been considered appropriate (J. Sundet, Norwegian Institute of Fisheries and Aquaculture, Tromsø, Norway, pers. comm. Feb. 1995). Elsewhere, in Iceland, where there has been considerable experience with the species, an exploitation rate of 10% is the rule (G. Thorarinsdottir, Marine Research Institute, Reykjavik, Iceland, pers. comm. March 1995). The species is long-lived and has a low natural mortality. These suggest the necessity of low exploitation rates.

Our experience with this species in Canada is somewhat limited. Besides, we only have estimates of biomass for two aggregations on the Grand Banks within the 200 mi economic zone. Appropriate strategies for sustainability for a given time horizon should emphasize that the biomass in each of these areas is the result of several years of accumulated recruits. As is the norm for any scallop species, it will continue to be a low volume, high value fishery. Moreover, we have no information on how resilient these stocks are to fishing. However, the decline in overall CPUEs, the proportionate reduction in the catch of large meats to smaller ones, and the concomitant decline in research vessel abundance indices all point to localized stock depletion. Until the resource is better understood and proven, it would be appropriate to adopt a cautious, experimental management strategy.

Applying the 10% exploitation rate to the adjusted biomass estimates would provide the following catch levels for each of the two aggregations:

3L (northern area)	1000 t shellstock
3N (Lilly Canyon/Carson Canyon)	3000 t shellstock

There are other areas where densities may be sufficiently high to attract commercial attention (eg., the Eastern Shoals area in 3L and Nose of the Bank (3LN) outside of the 200 mi economic zone). However, we have no information on the size and distribution of these aggregations. Consequently, an extremely cautious approach should be adopted for these areas.

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Table 1. Survey areas and distribution of sets on the Grand Banks during a resource survey for Iceland scallops in July, 1994.

Division	Area (n mi^2)	No. of sets
3L	348 (29%)	73
3N	867 (71%)	178
Total	1215	251

Table 2. Area-specific mean numbers and weights (kg) of Iceland scallops per tow mile on Grand Bank, July 1994.

Division	Depth fished (m)		# sets	Mean # (±SD)	Mean weight (±SD)
	Mean	Range			
3L	83.0	74-91	73	318.0 (±933.0)	23.3 (±63.8)
3N	76.5	61-174	178	202.6 (±557.3)	17.3 (±45.5)
Overall	78.4		251	235.9 (±688.0)	19.0 (±51.4)

Table 3. Area-specific mean and modal shell heights (mm) of Iceland scallops on Grand Bank, July 1994.

Division	N	Mean shell height (mm) (±SD)	Modal shell height (mm)	Maximum	Minimum
3L	4,342	73.6 (±7.7)	76	101	21
3N	12,995	82.7 (±8.8)	85	110	10
Overall	17,337	80.4 (±9.4)	85	110	10

Table 4. Area-specific biological meat yields, average meat weights and meat counts/500 g of Iceland scallops from Grand Bank, July 1994.

Area	N	Whole weight* (kg)	Meat weight (kg)	x meat weight (g)	Count (#/500 g)	Yield (%)
3L	1,437	122.95	11.36	7.9	63.3	9.2
3N	3,822	361.04	52.16	13.6	36.6	14.5
Overall	5,259	483.99	63.52	12.1	41.4	13.1

* Whole weight = weight of scallops as caught. No barnacles/ epibionts cleaned off shells.

Table 5. Estimates of minimum trawlable biomass (kg, whole weight) of Iceland scallops in an area surveyed in NAFO Div. 3L, July 1994.

# sets	Total	Av./set	Units	Total weight	Variance
73	1698.67	23.2695	176326	4103005	4071.51

Total	Upper	Lower	Mean	Upper	Lower	Effective degrees of freedom
4,103,005	6,728,236	1,477,774	23.2695	38.1580	8.3809	72

Table 6. Estimates of minimum trawlable biomas (t, round) for two survey areas on the Grand Bank, July 1994, and the "commecial" concentrations within the survey areas. (Figures in parenthesis are percentages of the total survey area.)

	Survey Area			"Commercial Bed"*		
Division	Area ($n\ mi^2$)	# sets	MTB (t, round weight)	Area ($n\ mi^2$)	# sets	MTB (t, round weight)
3L	348	73	1,478-6,728 (x=4,103)	89 (26%)	26	1,209-4,541 (x=2,875) (70%)
3N	867	178	4,624-10,552 (x=7,588)	243 (28%)	58	3,926-7,583 (x=5,754) (76%)

* "Commercial bed" = areas defined by sets with >catches = 20kg (round) per tow. One aggregation in Div. 3L, two in Div. 3N.

Table 7. Size-specific meat weights (g) for Iceland scallops from Div. 3L and 3N computed from shell height/meat weight regressions, July 1994.

Shell height (mm)	Div. 3L	Div. 3N)
40	1.4	1.8
45	2.0	2.5
50	2.6	3.4
55	3.4	4.5
60	4.3	5.8
65	5.3	7.3
70	6.5	9.0
75	7.9	11.0
80	9.4	13.3
85	11.1	15.8
90	12.9	18.7
95	15.0	21.8
100	17.2	25.3

Div. 3L: $\log W = 2.7239 \log SH - 4.2112$ ($r^2 = 0.87$)

Div. 3N: $\log W = 2.8960 \log SH - 4.3889$ ($r^2 = 0.91$)

Table 8. Estimates of minimum trawlable biomass (kg, whole weight) of Iceland scallops in an area surveyed in NAFO Div. 3N, July 1994.

# sets	Total	Av./set	Units	Total weight	Variance
178	3074.56	17.2728	439294	7587849	2067.53

Total	Upper	Lower	Mean	Upper	Lower	Effective degrees of freedom
7,587,849	10,551,651	4,624,047	17.2728	24.0195	10.5261	177

Table 9. Area-specific natural mortalities for Iceland scallops on Grand Bank computed from ratio of cluckers to live scallops, August 1989 and July 1994. Clucker numbers are adjusted by a factor of 1.221 to allow for tow-induced disarticulation.

Area	Live	Cluckers	M	
			1989	1994
Div. 3L	4,581	527.47	-	0.181
Div. 3N	14,050	1,120.88	0.078	0.129
Total	18,631	1,648.35	-	0.142

Table 10. Iceland scallop landings from Div. 3LNO (t, round).

Year	Div. 3L	Div. 3N	Div. 3O	# of vessels
1992	17	2	-	1
1993	456	3	-	10
1994*	91	4,478	2	57

* preliminary

Table 11. Distribution of Iceland scallop meat count (percent of total sampled) from NAFO Div. 3N in 1994.

Meat count (#/lb)	"Combined - adjusted"	
	April	October
1-09	0	0.1
10-19	2.4	1.5
20-29	34.8	29.2
30-39	40.2	36.6
40-49	17.5	22.0
50-59	4.0	8.0
60-69	0.9	2.2
70-79	0.3	0.3
80+	0.1	0.1
N	2209	1071

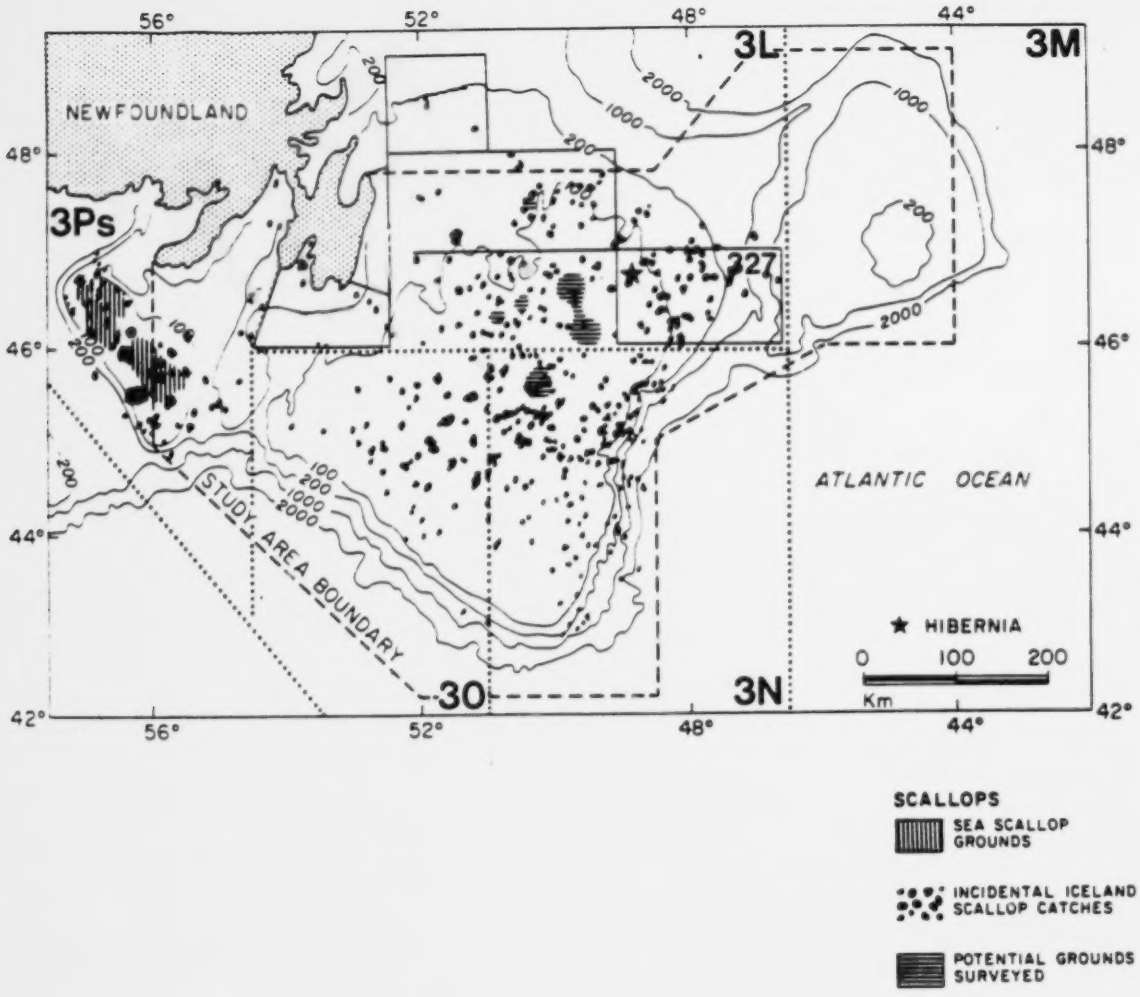

Fig. 1. Incidental presence in trawl catches of Iceland scallops on the Grand Banks of Newfoundland.

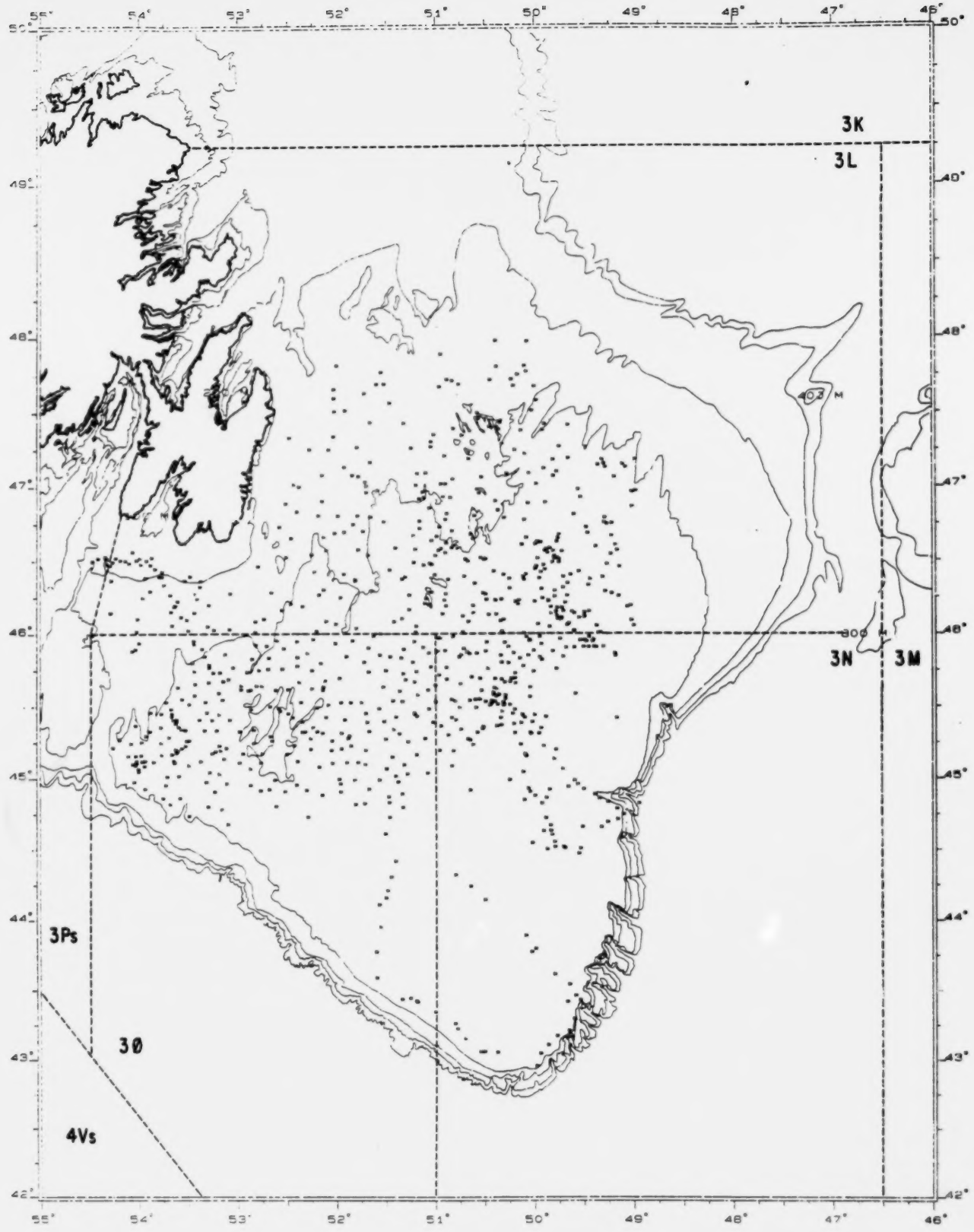

Fig. 2. Distribution of 1091 fishing stations during the 1982 Grand Bank Iceland scallop survey.

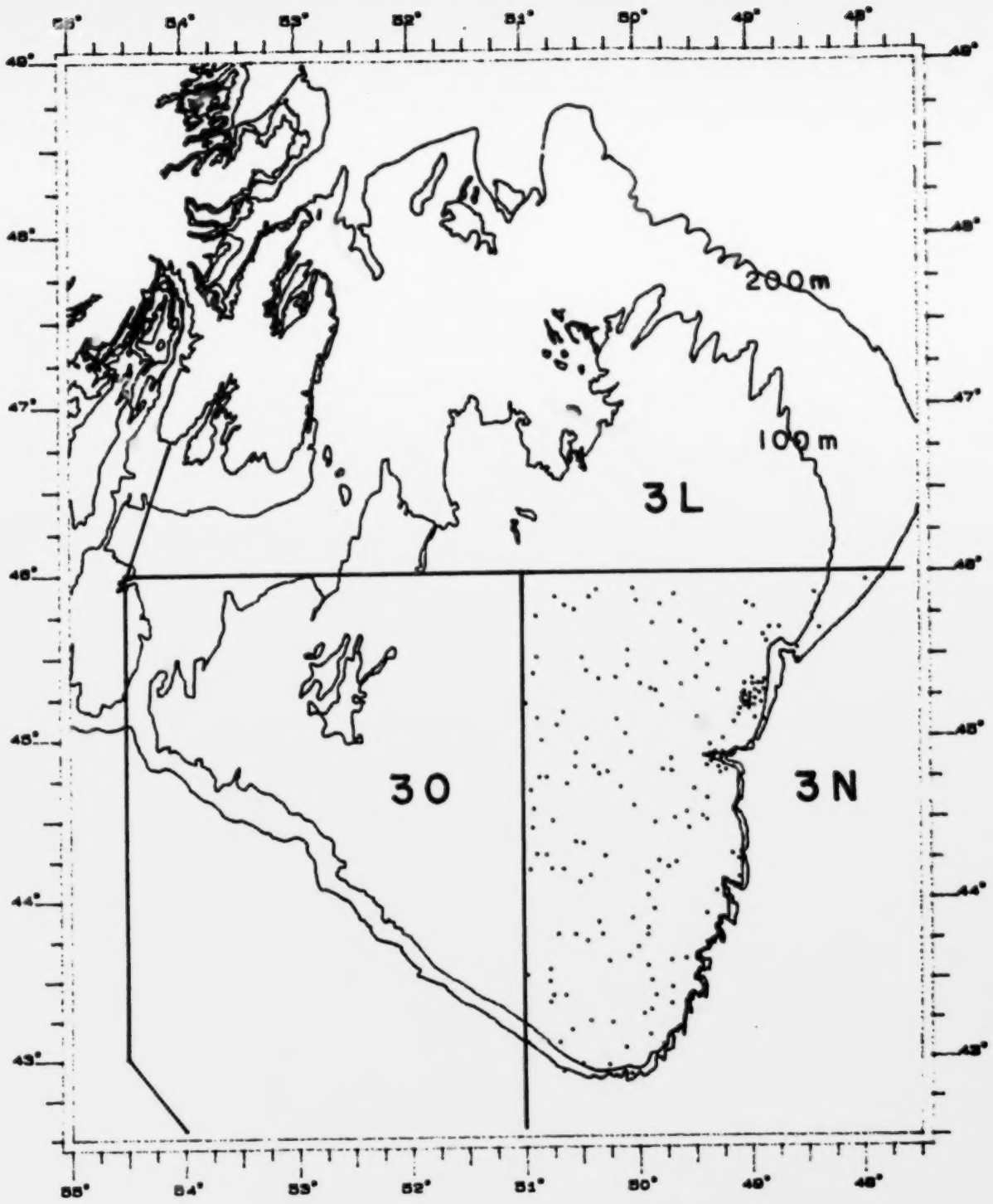

Fig. 3. Distribution of fishing stations in NAFO Div. 3N for the 1989 exploratory survey for Iceland scallops, Chlamys islandica.

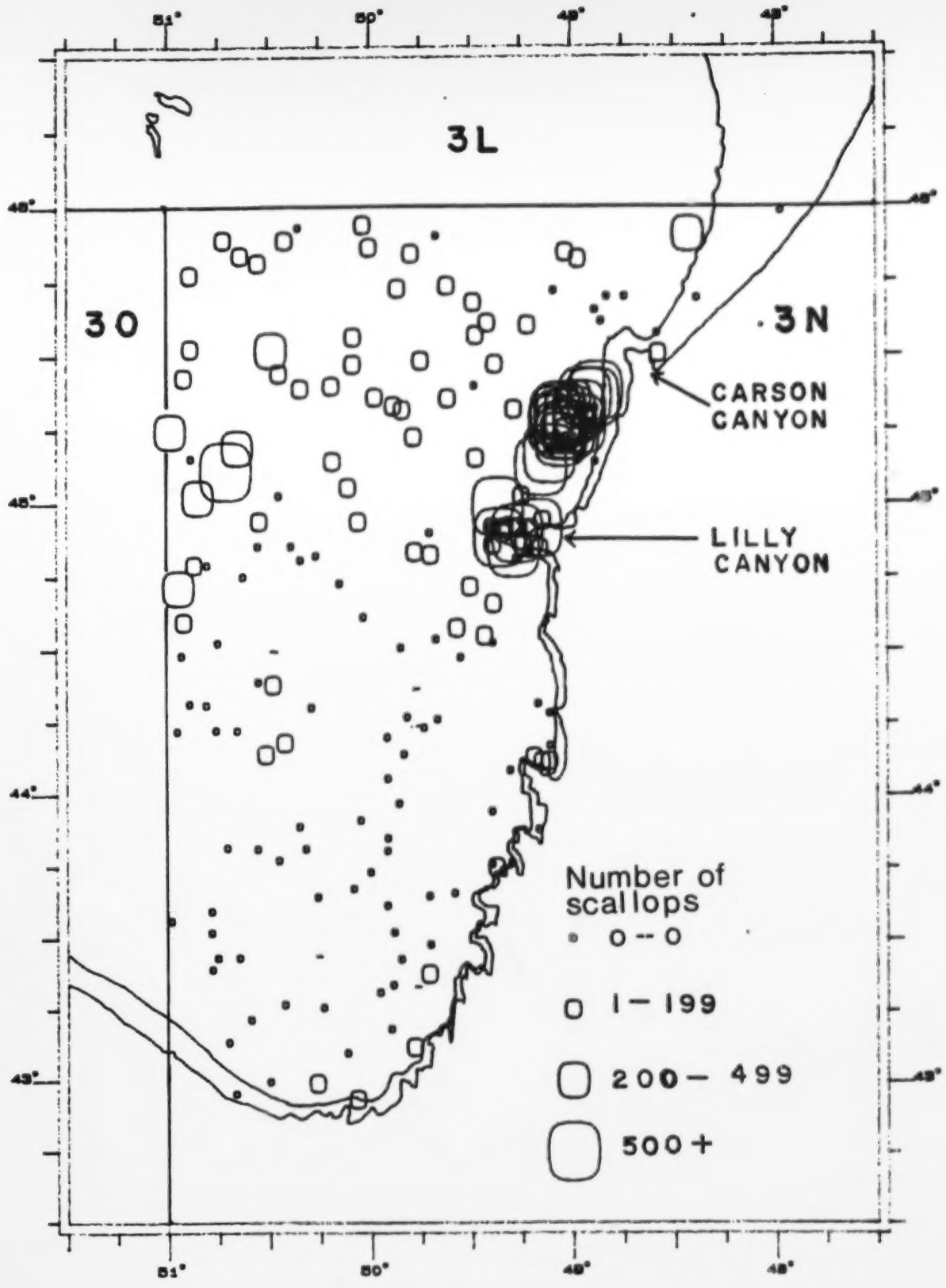

Fig. 4. Catches of Iceland scallops (no./tow) in NAFO Div. 3N (Grand Banks of Newfoundland) during a research vessel survey of the area in 1989.

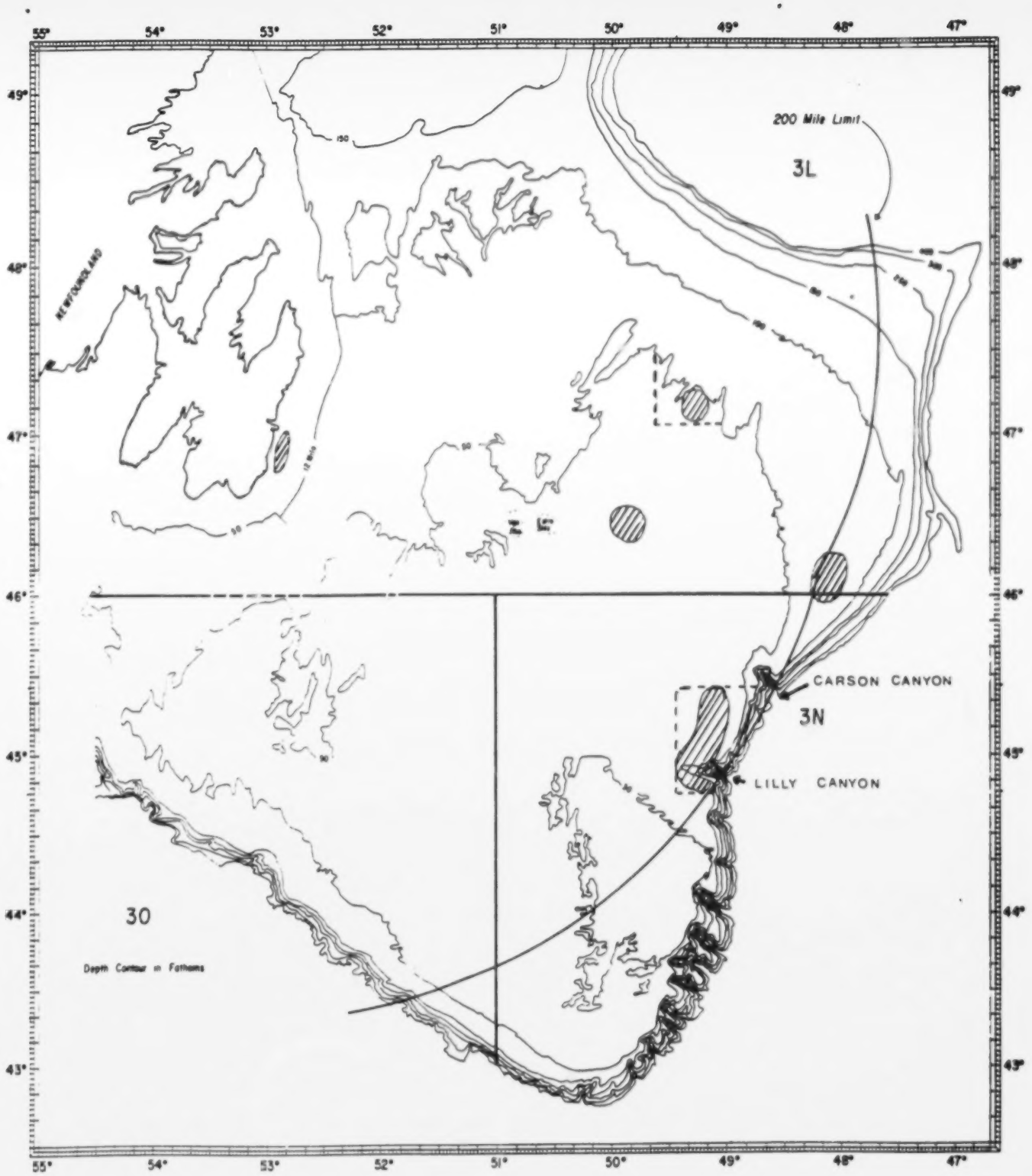

Fig. 5. NAFO Div. 3LNO showing known areas of Iceland scallop concentrations (cross hatched areas) and areas surveyed in 1994 (dotted lines).

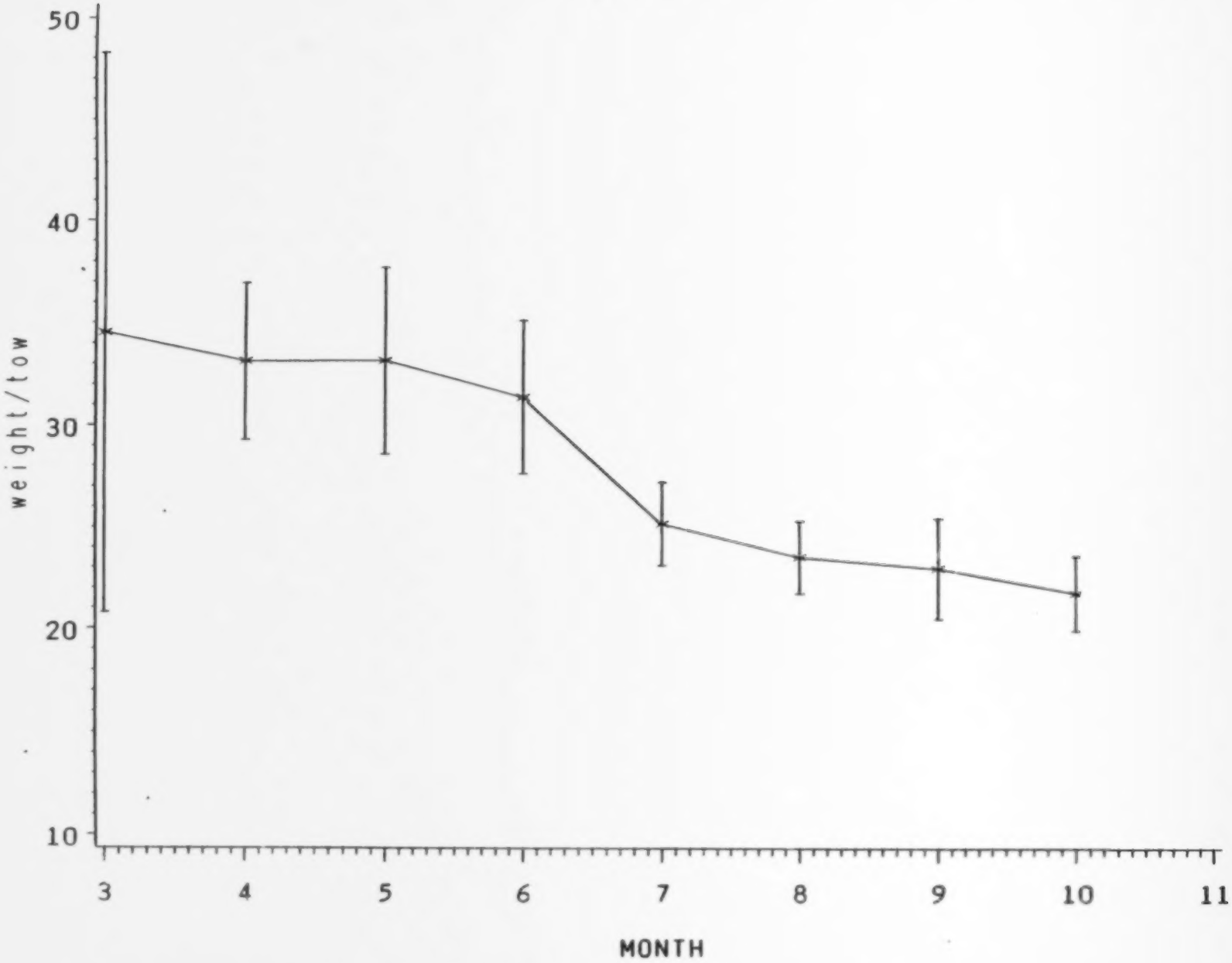

Fig. 6. Non-standardized CPUEs (mean daily catch (lbs. meats/tow) for Iceland scallops in the area surveyed in NAFO Div. 3N for 1994 for vessels that landed >=30,000 lbs (N = 16).